the spoil banks on either side; conveyors forming a bridge stretching across the channel, with cantilever arms projecting over the spoil banks on each side, carrying a steel travelling belt which conveys the material to the depositing ground; cantilever conveyors running on rails along one bank of the trench, with one arm dipping down into the excavations and the other rising over the spoil bank, up which incline a trolley is drawn for disposing of the earthwork; inclined planes leading to a travelling bridge with an open roadway extending over the spoil bank, through which wagons drawn up the incline deposit their load; and, lastly, high-power revolving derricks and other machinery for the rapid and economical removal and deposit of the excavations.

The novelty of the reservoir dam in progress at Assuan across the Nile consists in the one hundred and eighty sluices by which it is pierced affording a waterway of 24,000 square feet, through which the whole flow of the Nile in flood-time will be discharged, amounting to a maximum of 475,000 cubic feet per second with a velocity of 20 feet per second. These openings will be closed for storing up water for summer irrigation, by counterbalanced sluice-gates working on free rollers, which can be readily raised or lowered against a considerable head of water.

The deepening of the navigable channel by about 3½ feet outside the Sulina mouth of the Danube since 1895 by dredging, giving an available depth of 24 feet, shows that it is possible under favourable conditions to cope with the deposits of a minor channel of a deltaic river by means of dredging, at any rate for a time; though it must be anticipated that eventually the accumulations of deposit in front of the mouth will necessitate an extension of the jetties, to enable an improved scour across the advancing delta to aid dredging in the maintenance of the depth of the outlet channel.

The injuries caused during two successive winters to the superstructure on the top of a rubble mound, forming the main breakwater in progress for sheltering the approach to the River Nervion leading to the port of Bilbao, exposed as this breakwater is to the full force of the waves rolling in from the Bay of Biscay during north-westerly gales, has led to the adoption of a novel method of depositing blocks of concrete of unusual size for the purpose of providing a secure foundation for the superstructure in this exposed site, where the breakwater extends into a depth of about 50 feet at low tide. The method comprises the construction of metal caissons to serve as a lining for the blocks, which are ballasted with concrete, floated out into position, and sunk in place by filling them with water, after which they are filled as rapidly as possible with large concrete blocks, and with concrete in mass in the interstices and on the top, so as to constitute a solid block, the largest blocks thus formed at the Bilbao Harbour Works having a weight of about 1500 tons. These blocks, laid in a row on the top of a rubble mound at a depth of about 16½ feet below the lowest low water, within the shelter of the original rubble mound with its capping of large concrete blocks, have proved a perfectly stable foundation for the superstructure which is being erected upon them. This system is being extended at Zeebrugge Harbour in the North Sea, at the entrance to the Bruges Ship Canal, where steel caissons have been constructed and lined with concrete, which are to be floated into position in calm weather one by one for the foundations of sea and harbour walls along each side of a quay, and an outer solid breakwater; and these blocks, when completed, will rest on the sea bottom, and weighing from 2500 tons up to 4400 tons, will emerge about 2½ feet out of water at low water of spring tides, so that a solid superstructure can be readily built upon them.

Remarkable progress has been achieved in recent years in the extension of appliances for the more efficient lighting of minor shoals, outlying reefs, and navigable channels. The ease of rotation obtained by floating the illuminating apparatus on an annular mercury bath, has enabled the system of group flashes, giving a distinctive character to each light, to be extended to beacons exhibiting a continuously burning light for three or four months, by rotating the light apparatus by an electric battery placed in a chamber in the beacon. The increased speed of rotation, moreover, rendered possible by the floating on a mercury bath, has enabled the number of panels of lenses to be reduced and their size increased, and consequently a brighter flash to be exhibited. Various improvements also have been effected in the lights themselves. Thus carbonised wicks have been devised which enable a light to continue burning without being attended to for a considerable period, with only a moderate deterioration in intensity; incandescent lamps have been adopted, fed by oil gas or petroleum vapour, which provide an excellent light; and acetylene is being experimented upon by the French Lighthouse Service, and the danger of explosion having been overcome by using very small tubes for supplying the burner, it appears likely to furnish a very bright, serviceable light. Special attention has been lately devoted to reducing the divergence of the light exhibited by lightships from the vertical, as with a considerable rolling of the vessel in a storm the light is liable to be obscured for a time. As it has been ascertained by observation that the waves in severe storms have a fairly definite period of oscillation in any particular locality, the special period of oscillation of the waves where a lightship is to be placed is ascertained; and the vessel is so designed, and its weights adjusted, that its period of roll may differ materially from the oscillation of the waves at its station; and the roll of the lightship is further checked by giving it a large draught and deep bilge keels. Moreover, the light and its accessories are supported on a sort of compound pendulum, with weights so adjusted at the bottom and above the light that the oscillation of the pendulum differs from the roll of the vessel, and the stability and consequent visibility of the light is thereby increased.

Altogether the papers furnish interesting indications of some of the advances being achieved in the execution of waterways, maritime works, and the lighting of shoals and channels; and the prospect of important extensions of waterways is manifested by the Dortmund and Ems Canal, forming merely the first instalment of a waterway intended to connect most of the rivers of Prussia, and the proposal of a Russian engineer for constructing a deep waterway to connect the White Sea and the Baltic, capable of being traversed by large seagoing vessels.

ITALIAN GEOLOGY.[1]

AN elaborate memoir, containing results of a study of the rocks and geology of the basin of the Sesia with the exception of its lower portion, the Strona valley and the western portion of the Orta lake, has lately been issued. The authors remark that, having made traverses of this region in several directions, noting many stratigraphical details, they were obliged to recognise the impossibility of the task of determining the "absolute chronological value" of the different formations. Neither does their microscopic examination of the rocks help them more to unravel the stratigraphical problems. This is a result which is not infrequent where petrographical methods are treated as paramount. Petrography, as I have frequently laid stress upon, is but *an aid* to geology, a valuable one, I admit, but inferior to good and accurate field-work, lithology, and a wide general knowledge of the surrounding region, and especially of the habits in other regions of the same class of rocks.

The authors have, as they but too justly point out, to contend with the absence of any known fossiliferous horizon, or in fact any stratigraphical standard formation as a datum to work from. In addition a large mass of volcanics traverse the Valsesia between the two principal crystalline formations and produce uncertainty in the limits of each, further disturbing the already complex stratigraphical arrangement and masking the relations of one to the other. At the commencement of the paper is a bibliographical list of fifty-three memoirs dealing with the locality in question.

It was found convenient for the petrographical studies to divide the rocks of the higher basin of the Sesia into five groups:—

(1) Gneiss of Strona (with an appendix on the granites).
(2) Massive augitic and hornblendic rocks.
(3) Gneiss of Sesia (including the schists of Rimella and Fobello).
(4) Greenstones (pietre verde) properly so called.
(5) Gneiss of Monte Rosa.

The authors deserve much credit for not venturing beyond the old nomenclature of Gerlach and Parona, the earlier students of this region.

Under the first group are included mica-schists with silli-

[1] "Ricerche Petrografiche e Geologiche sulla Valsesia," by E. Artini and G. Melzi (*Mem. del R. Istituto Lombardo di Sc. e Lett.*, vol. xvii. pp. 219–392; pl. xxii.).

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manite, gneisses, biotitic granular, with two micas, scaly with microcline, fine grained biotitic, nodular amphibolic, dioritic, augito-hornblendic and fine grained tormaliniferous; augitic granulites, amphibolites, olivine and serpentiniferous rock and calciphyres (*i.e.* crystalline calcitic rocks containing more or less various silicates). In the appendix is included an examination of the granitites of Roccapietra, Quarna, and some vein granites.

The second group comprises diorites—micaceous, augitic and hornblendic; norites—simple and with hornblende; gabbros—simple and with garnet and with olivine; peridotites, pyroxenites and hornblendites are represented by lherzolites, harzburghites and websterites. The banded gabbros and stronalites are represented by banded augitic gabbros, banded hornblendic gabbros, stronalites. Basic dyke rocks, as spessartites, amphibolites and dioritic schists, are each given their share of microscopic researches. Some interesting observations are offered concerning the occurrence of schistose structure in these rocks.

Under group three are included light-coloured schistose gneisses, mica-schists and prasinitic rocks. A notable fact in this formation is the presence of thick bands and big masses of truly massive granitoid rocks intercalated between the more schistose kinds. These are of different types in which the characteristic element may be microcline, quartz, or of the type

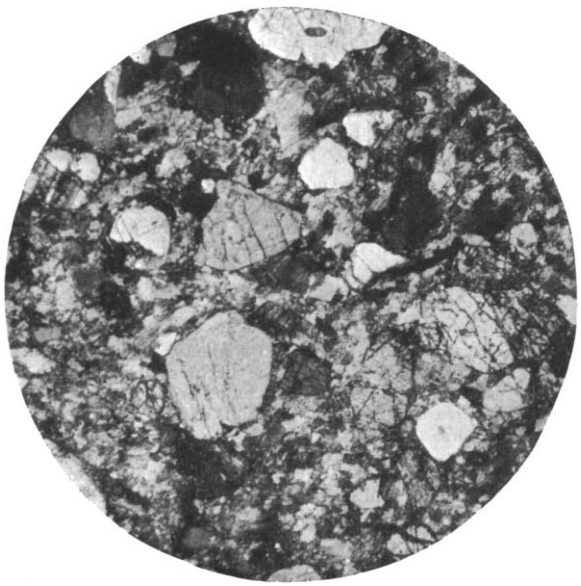

FIG. 1.—Calcifiro a Wernerite, con struttura clasticoporfirica.

of an augite-horneblende diorite. Though not attaining any notable development, still the nodular or *eyed* gneisses are interstratified with the other rocks of this formation, especially at Valle de Carcoforo and other localities.

Another member of this group which owes its structure to dynamic metamorphism is the finely-banded gneisses in the Val Grande. The structure of the limestones, calciphyres and schists of Rimella and Forbello are each carefully described.

The fourth group, included under the name of greenstones (pietre verde), though of less importance from the point of view of mass, present undoubtedly the most varied characters, such as prasinites, amphibolites, amphibolic schists, eclogites, serpentine, and oliviniferous rocks, calc-schists and saccharoidal limestones, garnetiferous mica-schists, and light-coloured gneisses and quartzite schists.

The final or fifth group, or gneisses of Monte Rosa, are remarkable for their uniformity of composition. The variations seem to consist chiefly of a porphyroidal, schistose, banded or tubular structure, passing by gradations to microgneisses and mica-schists.

The petrographical description of this large number of divers rocks and their varieties is very detailed, and appears to be done with much care. It is, of course, quite impossible to give even in outline a review of this in the space at our disposal. A clearer idea of the varied rock-structures is afforded by the large number of admirable photo-micrographs which the authors have executed themselves, and which are extremely well reproduced in the twenty plates devoted to this part of the subject.

The second section of the memoir is devoted to the geological characters of the rocks. Unfortunately, the authors are able to add little that is new, or add any facts of general interest. Observations of dip are recorded, as well as contact-phenomena between rocks of divers mineralogical and chemical composition. These physico-chemical effects seem to be most variable—highly developed at one spot, and hardly to be remarked at others; no attempt, however, is made to explain these variations.

The authors deny the absence of contact effects, as asserted by Schaefer and Salomon, and between the basic eruptive rocks and the gneiss of Strona, and give some striking examples. As to the basic eruptive rocks, the authors show they are posterior to the Strona gneiss, and discuss their relative age to the Sesia gneiss. The other groups are treated rather from the point of view of their petrographical characters than from their geological aspect.

Cleavage and foliation, the effects of dynamo-metamorphic processes, is well developed in one part of the region, and quite absent in another; but few details of the types of foliation,

FIG. 2.—Prasinite Cloritica, struttura microocellare.

and other changes, are offered the reader. The difference o interpretation of the relative ages and relations of the Strona and Sesia gneisses, with Parona, is fully portrayed in a tabular form of Messrs. Artini and Melzi's views.

The greenstones of this region the authors collegate, and even consider to be identical, with the greenstones of the Western Alps, lately pronounced by the *Comitato Geologico* to be Triassic and Liassic; whilst the gneiss of Monte Rosa they consider as Palæozoic or even Archaic.

A good geological map in colours of the region under consideration is given, and another coloured plate is devoted to sections. This work represents a great deal of patient labour in a difficult region, and, altogether, the authors are to be congratulated on their work. A little more charity to their opponents might here and there be allowed. It might also suggest itself to their mind that Germany does not hold a monopoly of petrographical research; that in France, and even in poor little England—not to speak of America, Norway, and other countries— many problems that are concerned in this memoir have been tackled, the published results of which might afford them some additional information.

H. J. JOHNSTON-LAVIS.

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